

1 CLAIMS

2 What is claimed is:

- 3 1. A tool disposable within a wellbore casing comprising:
- 4 an electro-magnetic coupling device comprising a coil and a magnet that is capable of
- 5 coupling acoustic energy within the wellbore casing and an electrical current
- 6 communicable with said coil.
- 7 2. The tool of claim 1, wherein said coupling comprises inducing acoustic energy
- 8 through the wellbore casing.
- 9 3. The tool of claim 1 wherein said coupling comprises recording acoustic energy
- 10 received from the wellbore casing.
- 11 4. The tool of claim 1 wherein said coupling comprises inducing acoustic energy through
- 12 the wellbore casing and recording acoustic energy received from the wellbore casing.
- 13 5. The tool of claim 1, further comprising a housing insertable within the wellbore
- 14 casing, said housing adapted to accommodate said magnetic coupling device.
- 15 6. The tool of claim 1 further comprising an electrical source capable of providing
- 16 electrical energy to said coil.
- 17 7. The tool of claim 1, further comprising a recording circuit capable of receiving signals
- 18 recorded by said magnetic recording device.
- 19 8. The tool of claim 1, wherein said magnet is selected from the group consisting of a
- 20 permanent magnet, a direct current electro-magnet, and an alternating current electro-
- 21 magnet.

- 1 9. The tool of claim 1, wherein said electro-magnetic coupling device is capable of
2 forming a wave within the casing, said wave having a waveform selected from the
3 group consisting of compressional waves, shear waves, transversely polarized shear
4 waves, Lamb waves, Rayleigh waves, and combinations thereof.
- 5 10. The tool of claim 1, wherein said electro-magnetic coupling device comprises an
6 electromagnetic acoustic transducer.
- 7 11. The tool of claim 5 comprising at least two electro-magnetic coupling devices
8 disposed onto said housing.
- 9 12. The tool of claim 11, wherein said electro-magnetic coupling devices are disposed at
10 substantially the same radial location with respect to the axis of said housing.
- 11 13. The tool of claim 11, wherein said electro-magnetic coupling devices are disposed at
12 varying radial locations with respect to the axis of said housing.
- 13 14. The tool of claim 13, wherein said electro-magnetic coupling devices comprise at least
14 one transmitter and at least one receiver, wherein said at least one transmitter is
15 disposed at substantially the same location along the length of said housing and said at
16 least one receiver is disposed at substantially the same location along the length of
17 said housing.
- 18 15. The tool of claim 13, wherein said magnetic coupling devices comprise at least one
19 transmitter and at least one receiver, wherein said at least one transmitter and said at
20 least one receiver are disposed at different locations along the length of said housing.
- 21 16. The tool of claim 1, further comprising two or more rows of magnetic coupling
22 devices comprising at least one transmitter and at least one receiver disposed radially
23 with respect to the axis of said housing.

- 1 17. The tool of claim 16, wherein each of said two or more rows are staggered.
- 2 18. The tool of claim 17, wherein each of said at least one transmitter and at least one
3 receiver are substantially helically arranged.
- 4 19. The tool of claim 1, wherein the use of said device is selected from the group
5 consisting of analyzing a bond adhering the wellbore casing to the wellbore, analyzing
6 characteristics of the wellbore casing, analyzing characteristics of wellbore cement,
7 and analyzing the formation surrounding the wellbore casing.
- 8 20. A cement bond log apparatus comprising:
9 a housing formed for insertion within a wellbore casing;
10 a magnetic coupling device disposed within said housing comprising a coil and a
11 magnet, wherein said coil and said magnet are combinable to produce an energy field
12 upon the passing of an electrical energy through said coil thereby magnetically
13 coupling said magnetic coupling transmitter with the wellbore casing thereby capable
14 of forming a transducerizing couple with the wellbore casing.
- 15 21. The device of claim 20, wherein said transducerizing couple comprises creating an
16 energy field that is capable of inducing acoustic energy through the wellbore casing.
- 17 22. The device of claim 20 wherein said transducerizing couple comprises recording
18 acoustic energy received from the wellbore casing.
- 19 23. The device of claim 20 wherein said transducerizing couple comprises creating an
20 energy field that is capable of inducing acoustic energy through the wellbore casing
21 and recording acoustic energy received from the wellbore casing.
- 22 24. The bond log device of claim 20 further comprising an electrical source capable of
23 providing electrical energy to said coil.

- 1 25. The cement bond log apparatus of claim 20, further comprising a recording circuit
2 capable of receiving signals recorded by said magnetic recording device.
- 3 26. The cement bond log apparatus of claim 20, wherein said magnet is selected from the
4 group consisting of a permanent magnet, a direct current electro-magnet, and an
5 alternating current electro-magnet.
- 6 27. The cement bond log apparatus of claim 20, wherein said magnetic coupling
7 transmitter is capable of producing a wave having a waveform selected from the group
8 consisting of compressional waves, shear waves, transversely polarized shear waves,
9 Lamb waves, Rayleigh waves, and combinations thereof.
- 10 28. The cement bond log apparatus of claim 20, wherein said magnetic coupling
11 transmitter comprises an electromagnetic acoustic transducer.
- 12 29. The cement bond log apparatus of claim 20 comprising at least two magnetic coupling
13 devices disposed onto said housing.
- 14 30. The device of claim 29, wherein said magnetic coupling devices are disposed at
15 substantially the same radial location with respect to the axis of said housing.
- 16 31. The cement bond log apparatus of claim 29, wherein said magnetic coupling devices
17 are disposed at varying radial locations with respect to the axis of said housing.
- 18 32. The cement bond log apparatus of claim 31, wherein said magnetic coupling devices
19 comprise at least one transmitter and at least one receiver, wherein said at least one
20 transmitter is disposed at substantially the same location along the length of said
21 housing and said at least one receiver is disposed at substantially the same location
22 along the length of said housing.

- 1 33. The cement bond log apparatus of claim 31, wherein said magnetic coupling devices
2 comprise at least one transmitter and at least one receiver, wherein said at least one
3 transmitter and said at least one receiver are disposed at different locations along the
4 length of said housing.
- 5 34. The cement bond log apparatus of claim 20, further comprising two or more rows of
6 magnetic coupling devices comprising at least one transmitter and at least one receiver
7 disposed radially with respect to the axis of said housing.
- 8 35. The cement bond log apparatus of claim 34, wherein said two or more rows are
9 staggered.
- 10 36. The cement bond log apparatus of claim 35, wherein each of said at least one
11 transmitter and at least one receiver are substantially helically arranged.
- 12 37. A method of inducing an acoustic wave through a casing disposed within a wellbore
13 comprising:
14 combining a magnetic field with an electrical field thereby inducing acoustic energy
15 through the casing;
16 sensing the acoustic energy propagating through the wellbore casing; and
17 analyzing the acoustic energy propagating through the wellbore casing.
- 18 38. The method of claim 37 further comprising, forming the magnetic field and the
19 electrical field with a magnetically coupled transducer and receiving the reflected
20 waves with a receiver.
- 21 39. The method of claim 38, wherein the magnetically coupled transducer comprises a
22 magnet and a coil.

- 1 40. The method of claim 39, wherein said magnet is selected from the group consisting of
2 a permanent magnet, a direct current electro-magnet, and an alternating current
3 electro-magnet.
- 4 41. The method of claim 38, wherein the magnetically coupled transducer comprises an
5 electromagnetic acoustic transducer.
- 6 42. The method of claim 39 further comprising adding an electrical source to said coil.
- 7 43. The method of claim 39 further comprising adding a recording circuit capable of
8 receiving signals recorded by said magnetic recording device.
- 9 44. The method of claim 37 wherein the acoustic energy induced by the combination of
10 said magnetic field with said electrical field include acoustic waves selected from the
11 group consisting of compressional waves, shear waves, transversely polarized shear
12 waves, Lamb waves, Rayleigh waves, and combinations thereof.
- 13 45. The method of claim 38 wherein said magnetically coupled transducer comprises at
14 least one transmitter and at least one receiver on a sonde disposed within the casing,
15 wherein the sonde is in operative communication with the wellbore surface.
- 16 46. The method of claim 45 wherein said magnetic coupling transmitter and said receiver
17 are disposed at substantially the same radial location with respect to the axis of the
18 casing.
- 19 47. The method of claim 45 wherein said magnetic coupling transmitter and said receiver
20 are disposed at varying radial locations with respect to the axis of the casing.
- 21 48. The method of claim 45 wherein said magnetic coupling transmitter and said receiver
22 are disposed at substantially the same location along the length of the casing.

- 1 49. The method of claim 45 wherein said magnetic coupling transmitter and said receiver
2 are disposed at different locations along the length of the casing.
- 3 50. The method of claim 37 further comprising two or more rows disposed radially with
4 respect to the axis of the casing, wherein each said two or more rows includes at least
5 one transmitter and at least one receiver.
- 6 51. The method of claim 50 wherein said two or more rows are staggered.
- 7 52. The method of claim 51 wherein each of said at least one magnetic coupling
8 transmitter and at least one receiver are substantially helically arranged.
- 9 53. The method of claim 37 further comprising conducting an analysis selected from the
10 group consisting of analyzing a bond adhering the wellbore casing to the wellbore,
11 analyzing characteristics of the wellbore casing, and analyzing the formation
12 surrounding the wellbore casing.
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